REMARKS

Claim 1 and 24-27 are currently pending.

Claim 1 is amended. Claims 24-27 are cancelled. New claims 28-37 are hereby added.

Therefor, claims 1 and 28-37 are presented for examination.

Claim Rejections under 35 U.S.C. §103

Boariu, et al. in view of El-Gamel, et al.

Claim 1 was rejected under 35 U.S.C 103(a) as being unpatentable over U.S. Patent No. 6,865,237 of Boariu, et al. (*Bouriu*) in view of U.S. Patent No. 7,010,053 of El-Gamel (*El-Gamel*). Claim 1 has been amended as described below.

Boariu, et al. and El-Gamel, et al. in view of Lee, et al.

Claim 24 was rejected under 35 U.S.C 103(a) as being unpatentable over *Boariu* and *El-Gamel* in view of article "A Space-Frequency Transmitter Diversity Technique for OFDM Systems" of Lee, et al. (*Lee*). Claim 24 has been cancelled.

Boariu, et al. and El-Gamel, et al. in view of Lee, et al.

Claim 24 was rejected under 35 U.S.C 103(a) as being unpatentable over *Boariu*, *El-Gamel*, and *Lee* in view of U.S. Patent No. 7,224,744 of Giannakis, et al (*Giannakis*). Claims 25-27 have been cancelled.

For at least the reasons set forth below, Applicants submit that claim 1 and new claims 28-37 are not rendered obvious by combinations of the *Boariu*, *El-Gamel*, *Lee*, and *Giannakis* references.

Claim 1, as amended herein, is as follows:

1. A method comprising:

receiving content for transmission over a multicarrier communication channel having *Nc* subcarriers, the transmission to be made via a plurality of three or more transmit antennae, the number of transmit antenna being M and the received content being vectors of input symbols of size $Nc \times 1$;

generating a rate-one, space-frequency code matrix from the received content for the transmission via the plurality of transmit antennae to a plurality of receive antennae, wherein generating the rate-one space frequency code matrix comprises:

dividing a vector of input symbols into *G* groups of vectors,

multiplying each of the G groups by a constellation rotation pre-coder to produce a number *G* of pre-coded vectors,

dividing each of the pre-coded vectors into groups of subvectors, and utilizing the subvectors to generate a diagonal matrix, and

interleaving the submatrices from the G groups to generate a rate-one space-frequency matrix of size M×Nc; and

transmitting the rate-one space-frequency matrix via the plurality of transmit antennae.

Among other differences, claim 1 includes generating the rate-one space frequency code matrix comprising dividing a vector of input symbols into *G* groups of vectors, multiplying each of the G groups by a constellation rotation pre-coder to produce a number *G* of pre-coded vectors, dividing each of the pre-coded vectors into groups of subvectors, and utilizing the subvectors to generate a diagonal matrix, and interleaving the submatrices from the G groups to generate a rate-one space-frequency matrix of size M×Nc. It is submitted that, among other differences, the combination of *Boariu*, *El-Gamel*, *Lee*, and *Giannakis* does not teach or suggest these claim elements.

The *Boariu* reference describes a system for digital signal transmission. Specifically, the reference regards a method and arrangement for transmitting a digital signal consisting of signal including a coder for coding comples symbols in blocks of length K. As the claimed invention is summarized:

> It is thus an object of the invention to implement a method and a system by which optimal diversity is achieved with different numbers of antennas. This is achieved by a method of transmitting a digital signal consisting of symbols, which method comprises the steps of coding complex symbols to channel symbols in blocks having the length of a given K and transmitting the channel symbols via several different channels and two or more antennas. In the method of the invention, coding is performed such that the coding is defined by a code matrix, which can be expressed as a sum of 2K elements, in which each element is a product of a symbol or symbol complex conjugate to be transmitted and a N×N representation matrix of a complexified anti-commutator algebra, extended by a unit element, and in which each matrix is used at most once in the formation of the code matrix.
>
> Further, in the method of the invention the coding is performed such that the coding is defined by a code matrix which is formed by freely selecting 2K-1 unitary, anti-hermitean N×N matrices anti-commuting with each other, forming K-1 pairs of said matrices, whereby the remaining matrix forms a pair with an N-dimensional unit matrix, forming two matrices of each pair such that the second matrix of the pair, multiplied by the imaginary unit, is added to and subtracted from the first matrix of the pair, and in which each matrix formed in the above manner defines the dependence of the code matrix on one symbol or symbol complex conjugate to be coded.

(*Boariu*, p. 9, lines 33-48) Thus, the process involves a coding in which includes the free selection of unitary, anti-hermitean N×N matrices that anti-commute with each other, and further forming pairs of such matrices, forming two matrices of each pair such that the second matrix of

each pair, when multiplied by a unitary unit, is added to and subtracted from the first matrix, and in which each matrix formed in the above manner defines the dependence of the code matrix on one symbol or symbol complex conjugate to be coded. The reference does not appear to teach or suggest the relevant elements of claim 1.

The *El-Gamel* reference regards a communication system for transmitting encoded signals over a communication channel. Specifically, the reference regards a transmitter including an encoder that generates a code word in response to a message signal, with the code word having a construction the defines a plurality of paths associated with an intersymbol interference (ISI) environment of the communication channel, where the code word is intended to achieve a diversity based on the number of transmit antennas and the number of ISI paths. (See *El-Gamel*, col. 2, lines 49-59) The reference thus does not appear to teach or suggest the relevant elements of claim 1.

The *Lee* reference regards a space-frequency transmitter diversity technique, which is described as utilizing orthogonal frequency division multiplexing (OFDM) to transform a frequency selective fading channel into multiple flat fading sub-channels on which space-frequency processing is applied. (*Lee*, p. 1473, abstract) The described system is illustrated in Figure 2 of the reference, in which a signal is converted from serial to parallel and coded into two vectors by a space-frequency encoder, with each vector being transmitted simultaeously from two base station antennas. (*Lee*, p. 1474) The described system does not appear to teach or suggest the relevant elements of claim 1.

The *Giannakis* reference regards space-time multi-path coding for frequency selective channels. The reference describes space-time coded multi-antenna transmissions over channels,

and more specifically describes space-time multipath coding techniques for frequency-selective channels. Further, the system utilizes digital phase sweeping (DPS), indicating "Digital phase sweeping techniques are described that enable maximum joint space-multipath diversity, and large coding gains. The techniques also afford a low-complexity modular implementation, when working with linearly precoded small-size groups of symbols. The techniques achieve a high rate of operation, in symbols per second per frequency, regardless of a symbol constellation used, and for any number of transmit-receive-antennae." (*Giannakis*, col. 2, lines 4-11)

For example, Figure 3 of *Giannakis* illustrates DPS-based space-time multipath techniques. As described, the system provides for selecting a number of groups and group size based on affordable complexity, and linear constellation precoder forming a precoded data stream. A power splitter then splits the power to form mirrored precoded data streams. DPS modules then apply digital phase sweeping and provide processing as follows:

> In particular, transmitter 4 estimates a delay lag for each of a plurality of multi-path channels from transmitter 4 to receiver 6, and computes a single channel vector from the estimated delay lags for the channels. DPS modules 54 (FIG. 2) processes the mirrored precoded data streams with the single channel vector to shift the delay lag of each of the channels so that channel taps become consecutive. Finally, transmitter 4 modulates each block c_{g} using OFDM and generates a transmission waveform via transmission antennas 20 (step 78).

(*Giannakis*, col. 10, lines 29-34) The described process does not appear to teach or suggest the relevant elements of claim 1.

It is thus submitted that the combination of the *Boariu*, *El-Gamel*, *Lee*, and *Giannakis* references does not teach or suggest generating the rate-one space frequency code matrix comprising dividing a vector of input symbols into *G* groups of vectors, multiplying each of the

G groups by a constellation rotation pre-coder to produce a number G of pre-coded vectors, dividing each of the pre-coded vectors into groups of subvectors, and utilizing the subvectors to generate a diagonal matrix, and interleaving the submatrices from the G groups to generate a rate-one space-frequency matrix of size M×Nc. It is thus submitted that claim 1 is patentable over the combination of *Booriu*, *El-Gamel*, *Lee*, and *Giannakis*.

Claims 28-37 are dependent on claim 1 and, while having other differences with the cited references, are allowable as being dependent on the allowable base claim.

Conclusion

Applicant respectfully submits that the rejections have been overcome by the amendment and remark, and that the claims as amended are now in condition for allowance. Accordingly, Applicant respectfully requests the rejections be withdrawn and the claims as amended be allowed.

Invitation for a Telephone Interview

The Examiner is requested to call the undersigned at (503) 439-8778 if there remains any issue with allowance of the case.

Request for an Extension of Time if Needed

The Applicant respectfully petitions for an extension of time to respond to the outstanding Office Action pursuant to 37 C.F.R. § 1.136(a) should one be needed. Please charge any fee to our Deposit Account No. 02-2666.

Charge our Deposit Account

Please charge any shortage to our Deposit Account No. 02-2666.

Respectfully submitted,

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